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GOOD PRACTICE CASE STUDY (UPDATE) 222

Purchasing policy for higher efficiency motors

ECC International

- Revised policy specifies the use of higher efficiency motors (HEMs) as the norm
- Energy savings already worth £100,000/year, on course for £400,000/year within five years
- New HEMs and soft starters replace wound rotor induction motors

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

GOOD PRACTICE CASE STUDY 222

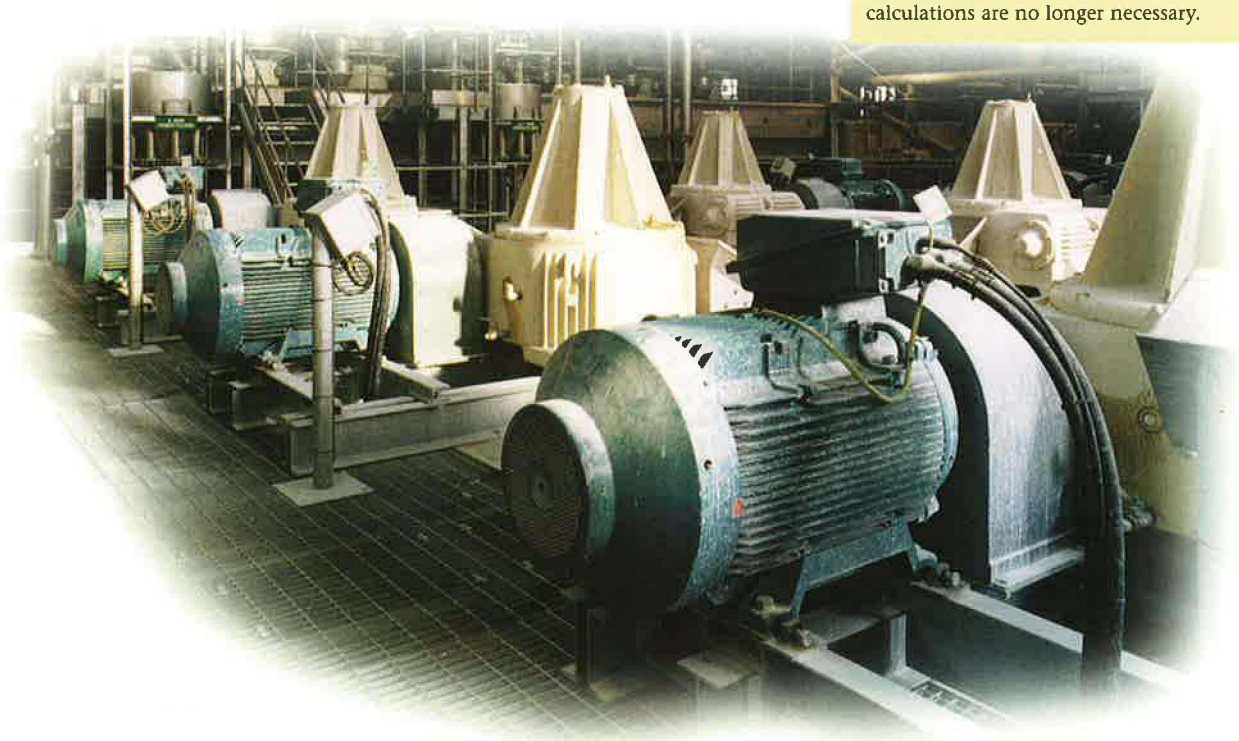
BACKGROUND

ECC International is the largest UK exporter of minerals. At its St Austell quarry china clay is extracted from granite by washing it out with high-pressure water jets. It then goes through several refining processes and is finally dried. Throughout most of the process the clay is transported as a slurry, with a high percentage of the 4,880 motors driving pumps to transport the clay. Most of the motors are three-phase, cage induction motors rated between 1 and 600 kW, many of them running 24 hours a day.

ECC International estimates that 85% of its electricity consumption can be attributed to these motors. To reduce lost production time, a further 800 motors are held in stock as replacements in the event of a motor failure.

The earlier motor purchasing policy featured in the original Good Practice Case Study 222* showed the detailed calculations, based on lifetime costs of ownership, that were used to determine which applications should be higher efficiency motors (HEMs). This involved a specially designed spreadsheet which took particular account of the factors that determine the annual running costs of a motor (including the premium payable for HEMs at that time).

Since then, however, HEMs have become available without any price premium, which led to ECC International dramatically revising its motor purchasing policy in 1996. A key result is that the company now finds it economic to specify HEMs as the norm for all new and replacement applications, and so spreadsheet calculations are no longer necessary.



Information for the Case Study was provided by: SEW Consultancy. Tel: 01422 370067.

For more information about higher efficiency motors, please contact ETSU.

Front cover photograph courtesy of ECC International.

* An Energy Efficiency Best Practice Programme (EEBPP) publication, first printed in 1994.

HOST ORGANISATION

The competition within the markets we serve demands that we are continually striving to improve process efficiencies and to reduce our total cost of production. Additionally, because we form an integral part of the UK extractive industry we are fully conscious of the need to recognise environmental expectations and, in this respect, the efficient use of energy is a significant factor.

Having initiated the installation of energy efficient motors during 1986 we now intend to undertake a fundamental review of all energy consumption within our business. It is anticipated that this will lead, as a matter of policy, to the phased introduction of new energy efficient equipment across all areas of production, which should eventually give rise to a significant reduction in energy consumption.

The steps we are taking will re-affirm the commitment ECC International has made to the efficient use of energy and this commitment has recently been extended to seeking formal registration under ISO 14001.

Malcolm Walkey, Principal Energy Engineer,
ECC International

ENGLISH CHINA CLAY INTERNATIONAL

ECC International is the UK's largest exporter of minerals other than hydrocarbons. The kaolinite, or fine china clay, it produces from sites in Cornwall and Devon is used mainly as a coating in the paper industry and in the production of ceramics, paint and polymer.

INTRODUCTION OF HEMS WITH NO COST PREMIUM

DEVELOPMENT OF HEMS WITH NO COST PREMIUM

The demand by many motor purchasers for lowest purchase price has historically driven the design of motors. Because of this, the amount of expensive active materials, e.g. steel laminations and copper, has been reduced, resulting in lower motor efficiency. However, since the 1980s, motor manufacturers have recognised that some enlightened users looked at the lifetime costs of running electric motors and realised the benefits of higher efficiency. Initially, HEM designs used more active materials and it was necessary to charge a premium for the higher material costs incurred. Nevertheless, companies such as ECC International realised the benefits of HEMs and, after conducting field trials, introduced a policy of specifying HEMs (as described in the original version of Case Study 222).

However, continuing research into motor efficiency and manufacturing techniques has allowed some motor manufacturers to develop HEMs at a cost which does not command a premium, and these are now available as their standard product.

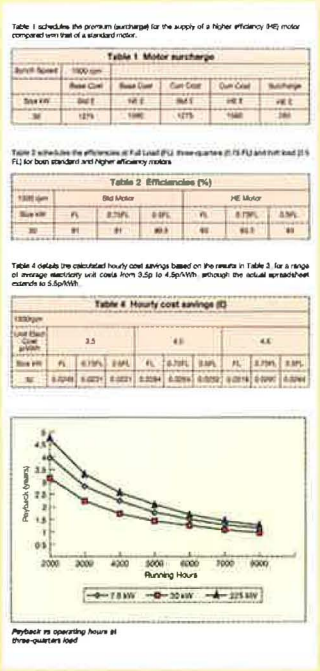


Table 1 Motor surcharge

Synch Speed	1500 rpm				
	Base Cost	Base Cost	Cum Cost	Cum Cost	Surcharge
Size kW	Std £	HE £	Std £	HE £	HE £
30	1275	1995	1275	1995	280

Table 2 Efficiencies (%)

1500 rpm	Std Motor			HE Motor		
Size kW	FL	0.75FL	0.5FL	FL	0.75FL	0.5FL
30	91	91	89.5	93	93.5	93

Table 4 Hourly cost savings (£)

1500rpm									
Unit Elect Cost p/kWh	3.5			4.0			4.5		
Size kW	FL	0.75FL	0.5FL	FL	0.75FL	0.5FL	FL	0.75FL	0.5FL
30	0.0249	0.0221	0.0221	0.0284	0.0254	0.0252	0.0319	0.0287	0.0284

Payback vs operating hours at three-quarters load

Excerpts from original Case Study showing some of the calculations used to determine when it was economic to use higher efficiency motors - no longer needed now that there is no price premium for HEMs

PREVIOUS MOTOR PURCHASING POLICY AT ECC INTERNATIONAL - KEY POINTS FROM THE ORIGINAL CASE STUDY

In the mid-1980s, ECC International's engineers compared standard motors with the then newly developed higher efficiency motors (HEMs). Their calculations showed that the HEMs produced paybacks of between 0.5 and 2.5 years, depending on the motor rating, running hours, load, and price of electricity.

To simplify the process of estimating savings over the wide range of motors on the various ECC International sites, a spreadsheet was developed which used motor manufacturers' catalogue data for standard motors and HEM efficiency at 100%, 75% and 50% load. The payback was based on the premium that had to be paid on an HEM and the savings made due to lower running costs. The calculations were verified by measurements on five HEMs installed at the company's pits, with ratings from 11 to 185 kW. As a result of this work, ECC International introduced a purchasing policy stating the following:

- All new plant, extensions and modifications to existing plant should, wherever economic, be specified with HEMs.
- All operational motor duties should be assessed on the basis of the spreadsheet and, if suitable, should be replaced with an HEM when required.
- Local stockists would be made aware of the policy and stocks of HEMs held accordingly.
- The rewinding and repair policy should be reviewed and amended, where financially viable, to one of replacement with HEMs.

During 1992, a total of 76 HEMs were purchased as a result of this policy. The premium charged for HEMs led to an investment of £16,050. Use of these HEMs saved some 266,844 kWh - worth £12,000/year - giving a simple payback of 1.3 years.

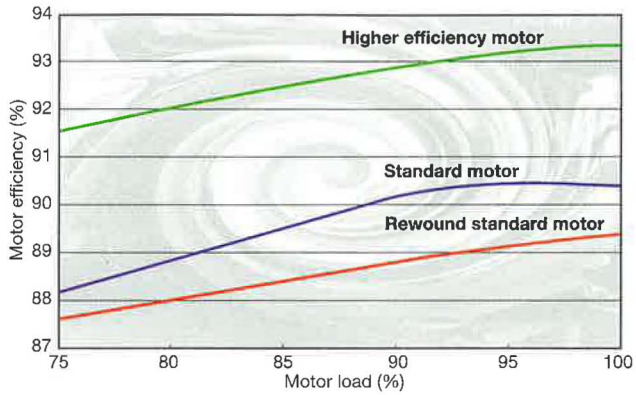

Case Study 222

Purchasing policy for higher efficiency motors

THE ACTION PLAN

REVISED ECC INTERNATIONAL MOTOR PURCHASING POLICY

When HEMs became available as the norm, ECC International immediately undertook in-house tests which confirmed the efficiency improvement claimed by the manufacturers.
(In-house test results on a 45 kW 4-pole motor are shown below.) As a result, the policy of purchasing HEMs was not only maintained, but accelerated and the spreadsheet developed by ECC International is no longer necessary.



*Efficiency comparison of 45 kW motors from data produced by ECC***

The tests at ECC International also measured the effect of motor repair and found that this typically reduces motor efficiency by 1%*. As a result, the company has modified its repair policy so that older standard motors which have failed are replaced with HEMs.

THE HEM ACTION PLAN

An action plan has been drawn up and approved by the ECC International board of directors, and a budget allocated.

Existing motors will be replaced with HEMs using the following action plan:

- All stock motors will be replaced with HEMs, (already done).
- A preventative maintenance schedule has been introduced. Vibration monitoring is used to check all motors routinely. Bearing problems are the most common cause of motor failure and, if a standard motor is identified as likely to fail, it will be replaced with an HEM. Similarly, if the winding of a standard motor fails, it will no longer be rewound but replaced with an HEM.
- A schedule of gradual replacement has been implemented, even if the motor is operating satisfactorily.
- Because many of the pumps have to pump a thick slurry with a high solids content, they require a high starting torque which has been achieved by using slipring motors. The new generation of HEMs has excellent starting characteristics, and with soft starters they can be used to replace slipring motors.
- In some applications variable speed would be an advantage, in which case it is possible to replace slipring motors with an HEM and a variable speed drive, which has an inherent soft starting capability.

Currently, about 25% of the company's installed motor capacity consists of HEMs, and the target is to convert all low voltage induction motors to HEMs within five years. This programme is already making annual energy savings worth £100,000, and is on course for savings of £400,000 within five years.

* New research has resulted in detailed guidance on the proper repair of motors for minimum energy losses. Adopting these procedures can keep the reduction in motor efficiency, and the corresponding increase in energy losses, to within 0.5%. In the light of this, ECC International is planning to undertake new tests and review its repair policy. A joint AEMT/EEBPP Good Practice Guide, *The repair of induction motors. Best practices to maintain energy efficiency*, is available from the Association of Electrical and Mechanical Trades, 177 Bagnall Road, Basford, Nottingham, NG6 8SJ. Tel: 0115 978 0086. Fax: 0115 978 4664. (Price: £36)

**Manufacturers' data shows that the efficiency at 75% load is very close to that at 100% load. (The difference is accounted for by differences in the methods used for measuring motor efficiency).

CONCLUSIONS

REPLACING SLIPRING MOTORS

Many of ECC International's pumps have to pump a thick slurry which has a high solids content, and so slipring motors were used to provide the high starting torque necessary. However, the new HEMs being used have a higher pull-out torque than the previous induction motors. So, in many cases the company is able to substitute slipring motors, and their associated control gear, with HEMs and soft starters. Replacing slipring motors with higher efficiency squirrel cage motors not only reduces energy costs but also considerably lowers the maintenance costs associated with the sliprings and brush gear, bringing additional savings in running costs.

In some pumping applications variable speed would be an advantage, in which case it is viable to use a variable speed drive instead of a soft start, as variable speed drives have a built-in soft starting capability.

CONCLUSIONS

ECC International has changed its motor purchasing and maintenance policies to reflect the recent availability of HEMs at no greater cost than standard efficiency motors. Management has committed to a new policy statement, and a budget has been agreed to accelerate the fitting of HEMs - both new and replacement purchases. This new policy commits ECC International to always buy HEMs, as this is now the most economic option in all cases (even for motors with very low running hours). By combining its motor purchasing policy with its motor maintenance policy, ECC International is able to accelerate the change to HEMs by replacing failed motors with HEMs where it is economic to do so.

Further information on creating a motor management policy is included in GPG 2, *Energy savings with electric motors and drives*, available from the ETSU Enquiries Bureau.

Further information

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Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy efficient techniques through Guides and Case Studies.

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Future Practice: reports on joint R & D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Energy Efficiency in Buildings: helps new energy managers understand the use and costs of heating, lighting etc.